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PHYTOTOXICOLOGY VEGETATION ASSESSMENT SURVEY: TONOLLI COMPANY OF CANADA LTD., MISSISSAUGA (1992)

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PHYTOXICOLOGY VEGETATION ASSESSMENT SURVEY

TONOLLI COMPANY OF CANADA LTD., MISSISSAUGA (1992)

Report prepared by:

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Phytotoxicology Section
Standards Development Branch

Abstract

Phytotoxicology Vegetation Assessment Survey: Tonolli Company of Canada Ltd., Mississauga (1992)

Tree foliage concentrations in the vicinity of Tonolli's secondary lead smelter still exceed the ULN guidelines for lead, arsenic and antimony. Foliar lead concentrations have decreased substantially from pre-1989 historically high levels. MOEE air monitoring data corroborate the Phytotoxicology findings. The improvement in air quality can be attributed to Tonolli abatement activities, the closure of Exide (an adjacent industrial lead source) and the phase-out of leaded gasoline.

SDB-159-3512-93

Introduction

In 1992, the MOE Central Region (Halton-Peel District office) requested that the Phytotoxicology Section conduct a vegetation assessment survey in the vicinity of Tonolli Company of Canada Ltd., 1333 Tonolli Road, Mississauga. The Phytotoxicology Section has surveyed lead contamination of vegetation and/or soil in the vicinity of Tonolli annually since 1970, 1988 being the only exception. As the Exide Canada smelter (east of the intersection of Dixie Road and Queensway Avenue) closed in August 1986, Tonolli is the only secondary lead smelter currently operating in the survey area. This report presents the results of the most recent 1992 survey in the area of Tonolli. The results of other Phytotoxicology surveys have been previously reported.

Recent vegetation surveys show that foliar concentrations of lead have declined markedly (1989-1991) since Tonolli was served with a control order by the MOE in July 1987. To comply with the control order, the company enclosed processing areas (crushing, mixing and delivery rooms) and the furnace lead smelting area. As a further measure to reduce particulate lead emissions, ventilation and dust collection systems have been improved/installed. In addition, traffic areas are kept wet and vehicles are washed before leaving the property. The air monitoring data further shows that the air quality has been improving since the control order (1987), and did not deteriorate significantly after it was rescinded in June 1990. The improvement in air quality is attributable to Tonolli abatement activities, the closure of Exide and the phase-out/ban of leaded gasoline.

In 1990, a soil replacement program was conducted in the neighbouring residential area (south of Queensway Ave.) to clean-up the soil lead contamination that has resulted from historical lead emissions from both Tonolli and Exide. In the fall of 1990, surface soil with a lead content greater than the MOE soil replacement level (500 ug/g) was replaced on affected properties/public boulevards in the residential areas, east and west of Dixie Road and south of Queensway Avenue. In the fall of 1991, surface soil also was replaced on contaminated public boulevards bordering Dixie Road and Queensway Avenue in the commercial area, north of Queensway Avenue.

Field Survey (1992)

On September 23, 1992, tree foliage was collected from the same 39 sites sampled in 1991. At all sites, tree foliage (primarily maple species) was collected from middle branches facing Tonolli. The samples were collected in duplicate, using standard sampling procedures. Surface soil was collected at these sampling sites in previous years, but not from 1986 to 1992. The foliage collection sites are shown in Figure 1.

The foliage samples were returned to the Phytotoxicology Laboratory. Here, the samples were oven-dried, ground and stored in glass jars. They were then submitted to the MOE Laboratory Services Branch for analysis of lead, arsenic, antimony and cadmium, all of which are potential components of emissions from Tonolli.

Results and Discussion

Lead

Table 1 shows the foliar lead concentrations that were detected from 1986 to 1992 at all sites, while Table 2 summarizes the 1986 to 1992 data from only the common maple sites within 400 meters, between 400 and 800 meters, and at greater than 800 meters from Tonolli. In both tables, the data exceeding the Phytotoxicology Section urban ULN guideline of 60 ug/g (see appendix) are underlined. As in previous years, the highest lead concentration was detected at Site 1 (580 ug/g) at the north limit of the Tonolli property. Concentrations of lead at other sites were markedly lower (ranging from 3 to 225 ug/g) and displayed a decreasing concentration with increasing distance from Tonolli.

In 1992, the concentration of lead at 26 of the 39 sample sites was marginally higher than in 1991 (Table 1). Table 2 shows that the mean lead concentration even for the closest maple sites (< 400 m) has increased only marginally from 149 ug/g in 1991 to 186 ug/g in 1992. The means for the maple sites beyond 400 meters also showed only a slight increase from the respective 1991 means. In spite of the slightly higher lead levels in 1992, the means for the common maple sites in both 1991 and 1992, including the sites closest to Tonolli, are the lowest concentrations since sampling was initiated. This is illustrated in Figure 2, which shows the lead results for common maple sites since 1981.

In 1992, the Phytotoxicology Section urban ULN guideline of 60 ug/g was exceeded at six sites, compared to four in 1991. Subsequent to 1987, the ULN has been exceeded each year at between four and seven sites. This is a significant decrease compared to the number of ULN exceedances in 1987 (16) and 1986 (20). After 1987, foliar lead levels exceeding the ULN have been confined to the commercial area, north of Queensway Avenue.

Arsenic, Antimony, Cadmium

The results for cadmium in tree foliage are not presented because most collection sites contained less than the analytical detection limit of 0.1 ug/g, with even the highest concentration (0.32 ug/g - Site 1) being well below the ULN (2 ug/g).

Tables 3 and 4 show the arsenic and antimony results from 1986 to 1992. Similar to lead, foliar concentrations of arsenic and antimony in 1992 were the highest at Site 1 in the immediate area of Tonolli and decreased with increasing distance from the company. In 1992, only the arsenic level at Site 1 (2.1 ug/g) marginally exceeded the ULN (2 ug/g), which is usually exceeded each year at one or two sites in the commercial area (Table 3). Table 4 shows that foliar concentrations of antimony were greater than the ULN (0.5 ug/g) at eleven sites, particularly Site 1 (20 ug/g), compared to 12 sites in 1991. In both 1991 and 1992, the above-normal antimony levels (>0.5 ug/g) were confined to the commercial area (except at Site 58), and there were fewer exceedances of the ULN compared to years previous (1986-1990). In contrast to lead, concentrations of arsenic and antimony at most sites were unchanged or slightly lower in 1992 compared to 1991. Figures 3 and 4 show that foliar concentrations of arsenic and antimony have declined from the relatively elevated levels in 1987, particularly in the immediate vicinity of Tonolli.

Air Monitoring Results

Figure 5 shows the annual (June-September) mean concentration of lead in total suspended particulate (TSP) for 1981 to 1992 at each of the two hi-vol stations (46045, 46046) in the survey area (see Figure 1), as well as the overall annual mean for both stations. The hi-vol at the Tonolli guard house (46041)) was discontinued in 1992. At Station 46045, the annual mean for lead in TSP declined for five consecutive years from 1988 to 1992. The air quality at Station 46046 has improved since 1986, but in 1992 the mean TSP lead concentration at this station and the overall mean for both stations was slightly higher than in 1991. In spite of this, the overall annual mean (both stations) in recent years (1989-1992) is substantially lower than historical concentrations (previous to 1989). The MOE ambient air quality criteria for lead in TSP (arithmetic and geometric means of 3 and 2 ug/m^3/30 days, respectively) has not been exceeded since 1988.

The dustfall results for 1992 were incomplete when this report was written. However, similar to TSP, the annual (June-September) means for lead in dustfall since 1986 have shown a similar trend downward. Since the TSP data showed only a slight deterioration in air quality from 1991, the dustfall data for 1992 is not likely to be markedly different from 1991. The MOE ambient air quality criteria for lead in dustfall (0.1 g/m^2/30 days) was not exceeded in 1991. The 1992 data that is available for June through September also is below the MOE criteria for lead in dustfall.

Conclusion

Foliar concentrations of lead, arsenic and antimony in the immediate area of Tonolli still exceed the respective ULN guidelines. However, foliar concentrations of these elements in recent years have declined markedly from the historically elevated concentrations previous to 1989, particulary at sites closest to Tonolli. Foliar lead levels in 1991 and 1992 were the lowest detected, even though 1992 levels were marginally higher than in 1991. The MOE air monitoring data further shows that air quality has improved since the 1987 control order, and did not deteriorate significantly since it was rescinded in 1990. Tonolli abatement activities, the closure of Exide and the phase-out/ban of leaded gasoline all have contributed to the improvement in air quality in the survey area.

Table 1: Lead Concentrations in Tree Foliage: Tonolli, Mississauga (1986-1992)

Site No.	Distance & Direction from Tonolli	Species (1989-92)	Lead Concentration*					
			1986	1987	1989	1990	1991	1992
1	80 m NW	Silver maple	1300	1950	965	1055	405	580
3	300 m NW	Silver maple	240	275	155	140	60	69
4	480 m NW	Silver maple	120	81	61	53	25	21
9	370 m N	Elm**	42	52	43	38	14	22
12	200 m NE	Nor. maple**	535	670	60	175	130	56
14	500 m NE	Apple	130	59	39	29	15	17
15	745 m NE	Elm**	32	17	9	19	14	4
18	290 m E	Silver maple	480	625	125	170	119	80
19	105 m SE	Nor. maple**	NR	NR	230	390	170	225
25	240 m S	Ash	340	180	150	220	56	135
27	490 m S	Apple	210	115	87	70	54	110
28	820 m S	Apple	49	33	8	8	9	9
29	1080 m S	Silver maple	16	40	20	27	12	12
30	230 m SW	Ash	99	140	57	60	49	55
36	350 m W	Man. maple	140	275	30	46	15	16
38	790 m W	Elm	53	50	22	32	9	10
42	520 m N	Ash**	79	44	20	15	5	9
49	495 m E	Honey locust	98	125	24	32	19	9
50	640 m E	Norway maple	41	40	10	13	9	6
51	820 m E	Elm	68	83	17	26	11	13
52	895 m E	Norway maple	15	22	5	7	3	3
54	615 m E	Norway maple	52	71	12	34	6	10
55	895 m E	Nor. maple**	NR	NR	9	10	6	6
56	1095 m E	Norway maple	18	16	7	5	4	5
57	1210 m E	Sugar maple	5	13	4	3	2	3
58	510 m E	Silver maple	240	102	31	47	24	28
59	610 m E	Norway maple	62	49	14	18	15	15
60	650 m SE	Silver maple	140	72	21	19	17	20
61	830 m SE	Norway maple	44	25	7	6	8	8
62	960 m SE	Norway maple	22	24	7	6	3	6
64	480 m SE	Norway maple	110	78	17	27	11	24
65	570 m SE	Sugar maple	62	44	18	27	11	21
66	600 m S	Ash	33	21	11	19	5	17
67	775 m S	Norway maple	31	16	10	15	6	13
68	350 m SE	Ash	230	190	43	54	31	60
71	630 m S	Apple	82	22	32	15	12	25
72	840 m S	Man. maple	13	15	6	7	2	18
73	575 m SW	Norway maple	NR	13	8	8	4	5
74	910 m E	Silver maple	NR	27	7	12	6	5

* ug/g, dry weight, mean of duplicate samples and analysis (1987-1992). Single samples were collected in 1986

** species sampled prior to 1989 was different

NR - not sampled, no results

Note: ULN guideline for lead in urban foliage - 60 ug/g. Values underlined exceed ULN, see appendix

Table 2: Foliar Concentrations of Lead at Common Maple Sites (1986-1992)

Site No.	Distance & Direction from Tonolli	Species	Lead Concentration*					
			1986	1987	1989	1990	1991	1992
Closest Sites Within 400 m of Tonolli								
1	80 m NW	Silver maple	1300	1950	965	1055	405	580
3	300 m NW	Silver maple	240	275	155	140	60	69
18	290 m E	Silver maple	480	625	125	170	119	80
36	350 m W	Man. maple	140	275	30	46	15	16
		Mean	540	781	318	352	149	186
Sites between 400 and 800 m								
4	480 m NW	Silver maple	120	81	61	53	25	21
50	640 m E	Norway maple	41	40	10	13	9	6
54	615 m E	Norway maple	52	71	12	34	6	10
58	510 m E	Silver maple	240	102	31	47	24	28
59	610 m E	Norway maple	62	49	14	18	15	15
60	650 m SE	Silver maple	140	72	21	19	17	20
64	480 m SE	Norway maple	110	78	17	27	11	24
65	570 m SE	Sugar maple	62	44	18	27	11	21
67	775 m S	Norway maple	31	16	10	15	6	13
		Mean	95	61	22	28	14	18
Sites Greater than 800 m of Tonolli								
29	1080 m S	Silver maple	16	40	20	27	12	12
52	895 m E	Norway maple	15	22	5	7	3	3
56	1095 m E	Norway maple	18	16	7	5	4	5
57	1210 m E	Sugar maple	5	13	4	3	2	3
61	830 m SE	Norway maple	44	25	7	6	8	8
62	960 m SE	Norway maple	22	24	7	6	3	6
72	840 m S	Man. maple	13	15	6	7	2	18
		Mean	19	22	8	9	5	8

* ug/g, dry weight, mean of duplicate samples and analysis (1987-1992). Single samples were collected in 1986. Note: Underlined values exceed urban ULN guideline of 60 ug/g, see appendix

Table 3: Arsenic Concentrations in Tree Foliage: Tonolli, Mississauga (1986-1992)

Site No.	Distance & Direction from Tonolli	Species (1989-92)	Arsenic Concentration*					
			1986	1987	1989	1990	1991	1992
1	80 m NW	Silver maple	5.8	10.0	3.7	2.6	2.2	2.1
3	300 m NW	Silver maple	1.5	2.2	0.7	0.6	0.4	0.3
4	480 m NW	Silver maple	0.6	0.7	0.4	0.4	0.3	<0.2
9	370 m N	Elm**	0.4	0.4	0.3	0.3	0.2	<0.2
12	200 m NE	Nor. maple**	1.7	3.3	0.4	0.6	0.9	0.3
14	500 m NE	Apple	0.6	0.6	0.5	0.4	0.6	0.4
15	745 m NE	Elm**	0.2	0.2	0.2	0.3	0.4	<0.2
18	290 m E	Silver maple	1.9	4.2	0.6	0.8	0.9	0.3
19	105 m SE	Nor. maple**	NR	NR	0.9	1.2	2.2	1.1
25	240 m S	Ash	1.5	1.6	0.7	0.9	0.6	1.0
27	490 m S	Apple	1.3	0.6	0.6	0.3	0.4	0.2
28	820 m S	Apple	0.4	0.3	0.3	0.3	0.2	<0.2
29	1080 m S	Silver maple	0.2	0.8	0.4	0.4	0.4	0.3
30	230 m SW	Ash	0.6	1.0	0.4	0.4	0.4	0.5
36	350 m W	Man. maple	1.1	1.3	0.3	0.4	0.3	<0.2
38	790 m W	Elm	0.4	0.4	0.3	0.3	0.2	<0.2
42	520 m N	Ash**	0.7	0.7	0.3	0.3	0.2	<0.2
49	495 m E	Honey locust	0.6	0.7	0.3	0.5	<0.2	<0.2
50	640 m E	Norway maple	0.2	0.5	0.2	0.5	0.2	<0.2
51	820 m E	Elm	0.4	0.6	0.3	0.3	0.3	<0.2
52	895 m E	Norway maple	0.3	0.3	0.2	0.2	0.2	<0.2
54	615 m E	Norway maple	0.4	0.7	0.3	0.3	0.3	<0.2
55	895 m E	Nor. maple**	0.8	0.9	0.4	0.4	0.7	0.5
56	1095 m E	Norway maple	1.2	1.8	0.7	0.8	0.9	0.5
57	1210 m E	Sugar maple	0.4	0.4	0.3	0.4	0.4	<0.2
58	510 m E	Silver maple	0.8	0.6	0.3	0.3	0.2	<0.2
59	610 m E	Norway maple	0.5	0.5	0.3	0.3	0.3	<0.2
60	650 m SE	Silver maple	0.7	0.6	0.3	0.3	0.4	0.2
61	830 m SE	Norway maple	0.7	0.4	0.5	0.6	0.3	0.2
62	960 m SE	Norway maple	0.3	0.3	<0.2	0.3	0.4	0.2
64	480 m SE	Norway maple	0.8	0.7	0.5	0.4	0.6	0.4
65	570 m SE	Sugar maple	1.7	2.0	1.1	1.0	1.7	1.4
66	600 m S	Ash	0.6	0.3	0.4	0.3	0.4	0.3
67	775 m S	Norway maple	0.4	0.3	0.3	<0.2	0.2	<0.2
68	350 m SE	Ash	1.8	2.1	0.4	0.4	0.3	0.3
71	630 m S	Apple	0.7	0.3	0.5	0.3	0.3	0.2
72	840 m S	Man. maple	0.2	0.3	0.3	0.2	0.3	0.2
73	575 m SW	Norway maple	NR	0.3	0.3	<0.2	0.2	<0.2
74	910 m E	Silver maple	NR	0.3	0.3	0.3	0.2	0.2
	Analytical Detection Limit		0.2					

* ug/g, dry weight, mean of duplicate samples and analysis (1987-1992). Single samples were collected in 1986

** different species sampled prior to 1989

NR - not sampled, no results

Note: Values underlined exceed Phytotoxicology Section urban ULN guideline (2 ug/g), see appendix

Table 4: Antimony Concentrations in Tree Foliage: Tonolli, Mississauga (1986-1992)								
Site No.	Distance & Direction from Tonolli	Species (1989-1992)	Antimony Concentration*					
			1986	1987	1989	1990	1991	1992
1	80 m NW	Silver maple	39.0	61.0	19.0	26.0	21.0	20.0
3	300 m NW	Silver maple	1.0	8.0	4.5	5.1	2.4	2.1
4	480 m NW	Silver maple	3.5	3.0	1.6	1.3	1.0	0.6
9	370 m N	Elm**	1.9	1.4	0.6	1.0	0.4	0.5
12	200 m NE	Nor. maple**	10.0	15.0	1.5	4.0	4.8	1.7
14	500 m NE	Apple	1.9	1.9	0.6	0.7	0.6	<0.2
15	745 m NE	Elm**	0.6	0.2	0.3	0.7	0.5	<0.2
18	290 m E	Silver maple	9.0	18.0	2.9	5.4	5.3	2.0
19	105 m SE	Nor. maple**	NR	NR	5.9	8.6	7.1	5.5
25	240 m S	Ash	9.4	5.2	3.6	4.4	1.7	3.0
27	490 m S	Apple	3.1	1.3	0.9	1.0	0.9	0.5
28	820 m S	Apple	1.7	0.3	<0.2	0.3	0.3	<0.2
29	1080 m S	Silver maple	2.5	0.9	0.3	0.8	0.3	0.2
30	230 m SW	Ash	2.3	3.4	0.8	0.7	0.9	0.8
36	350 m W	Man. maple	5.1	7.9	1.0	1.6	0.2	0.3
38	790 m W	Elm	1.1	1.3	0.3	0.6	<0.2	<0.2
42	520 m N	Ash**	2.1	1.9	0.3	0.4	<0.2	0.3
49	495 m E	Honey locust	3.4	2.8	0.3	0.4	0.5	<0.2
50	640 m E	Norway maple	1.1	1.9	0.3	0.4	0.2	<0.2
51	820 m E	Elm	1.7	2.2	0.2	0.6	0.2	0.2
52	895 m E	Norway maple	0.4	0.2	<0.2	0.3	<0.2	<0.2
54	615 m E	Norway maple	2.0	2.0	0.2	0.8	<0.2	0.3
55	895 m E	Nor. maple**	1.1	0.2	<0.2	0.3	<0.2	0.2
56	1095 m E	Norway maple	0.9	0.2	<0.2	0.4	0.2	<0.2
57	1210 m E	Sugar maple	0.2	0.3	<0.2	0.3	<0.2	<0.2
58	510 m E	Silver maple	5.7	2.5	0.6	1.3	0.6	0.7
59	610 m E	Norway maple	3.0	1.2	0.2	0.5	0.5	0.4
60	650 m SE	Silver maple	3.1	2.6	0.6	0.5	0.5	0.4
61	830 m SE	Norway maple	1.3	0.8	<0.2	0.3	0.2	0.2
62	960 m SE	Norway maple	0.7	0.3	<0.2	0.3	<0.2	<0.2
64	480 m SE	Norway maple	2.4	1.8	0.3	0.6	0.3	0.4
65	570 m SE	Sugar maple	2.0	1.0	0.4	0.8	0.3	0.4
66	600 m S	Ash	1.0	0.3	<0.2	0.4	0.2	0.2
67	775 m S	Norway maple	1.0	0.4	0.2	0.5	0.2	0.3
68	350 m SE	Ash	5.4	5.7	0.6	1.2	0.9	0.9
71	630 m S	Apple	1.6	0.4	0.3	0.3	<0.2	<0.2
72	840 m S	Man. maple	0.3	0.4	<0.2	0.3	<0.2	0.6
73	575 m SW	Norway maple	NR	0.3	<0.2	0.3	<0.2	0.2
74	910 m E	Silver maple	NR	0.5	0.2	0.5	<0.2	<0.2
Analytical Detection Limit			0.2					

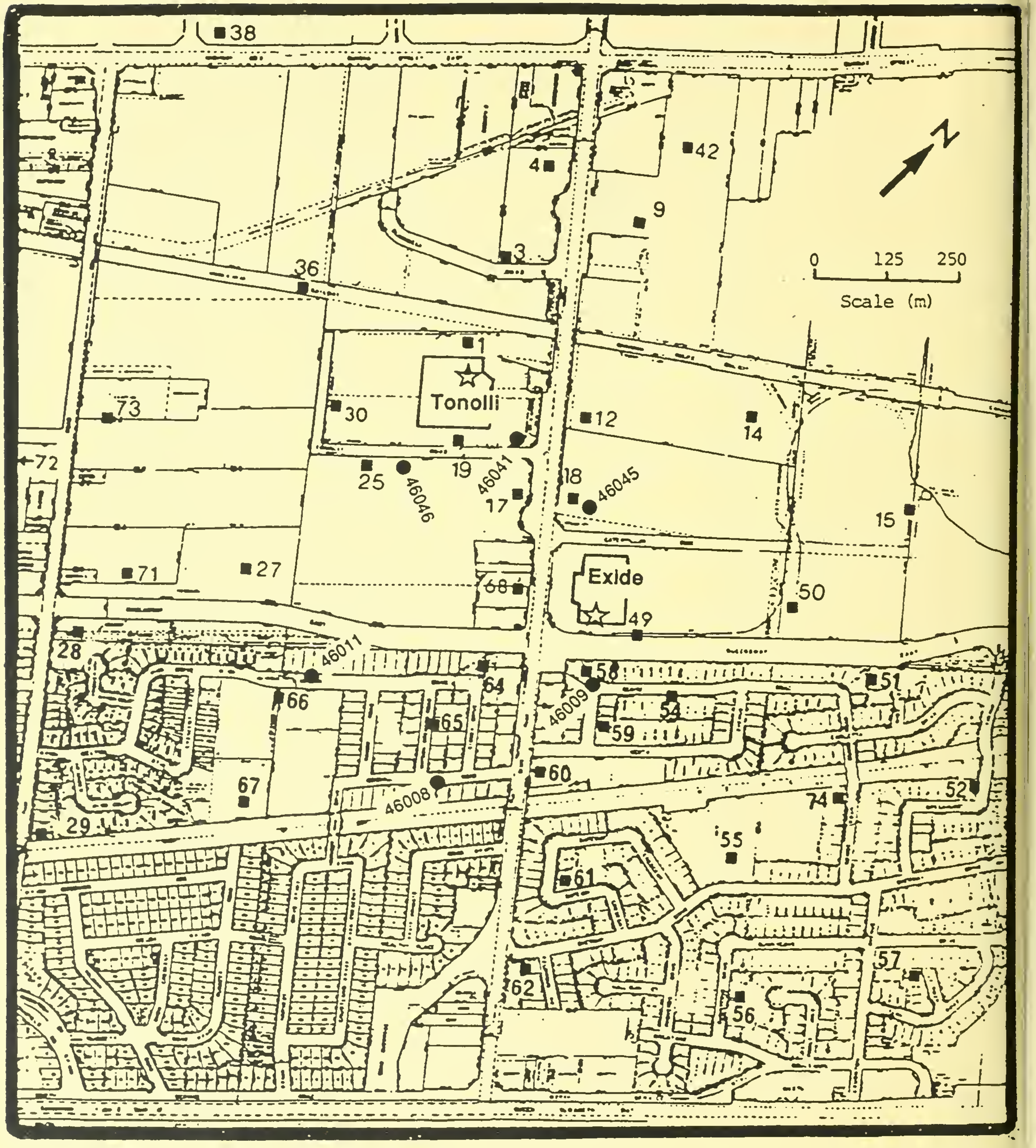
* ug/g, dry weight, mean of duplicate (1987-1992) samples and analysis. Single samples were collected in 1986

** different species sampled prior to 1989

NR - not sampled, no results

Note: Values underlined exceed Phytotoxicology Section urban ULN (0.5 ug/g), see appendix

Figure 1: Foliage Collection Sites And Air Monitor Stations In Area of Tonolli



● Dustfall - Stations 46008, 46009, 46011, 46041, 46045, 46046 ● Hi-Vol - Stations 46041, 46045, 46046
■ Foliage Collection Site

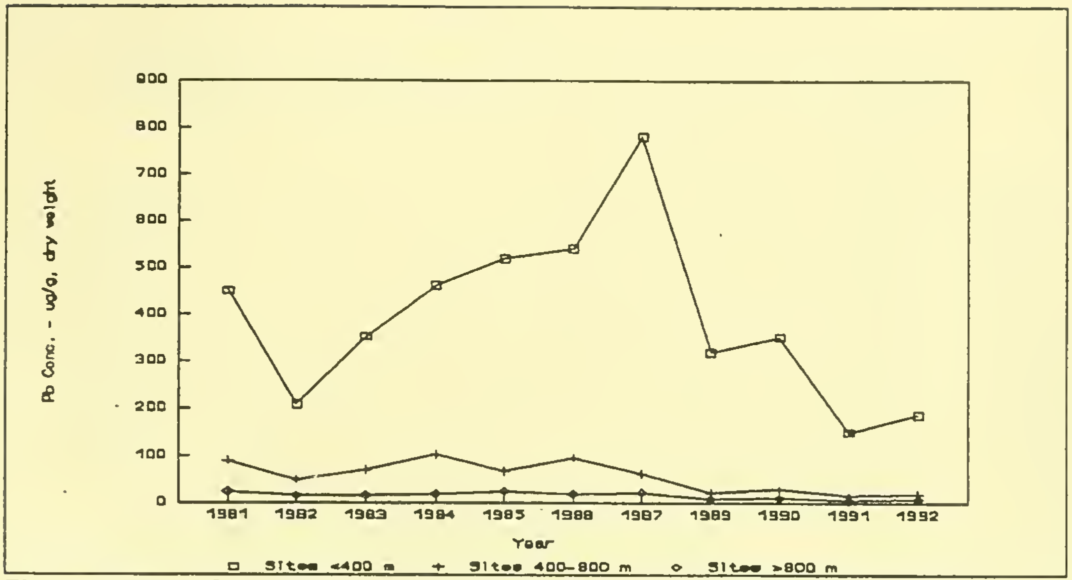


Figure 2: Mean Concentration of Lead at Common Maple Sites: 1981-1992

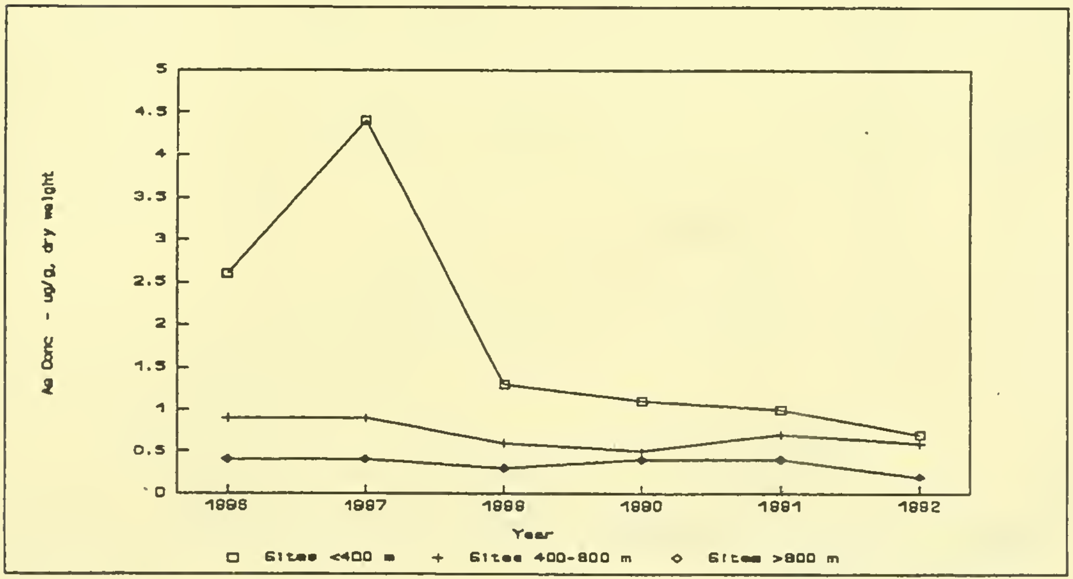


Figure 3: Mean Concentration of Arsenic at Common Maple Sites: 1986-1992

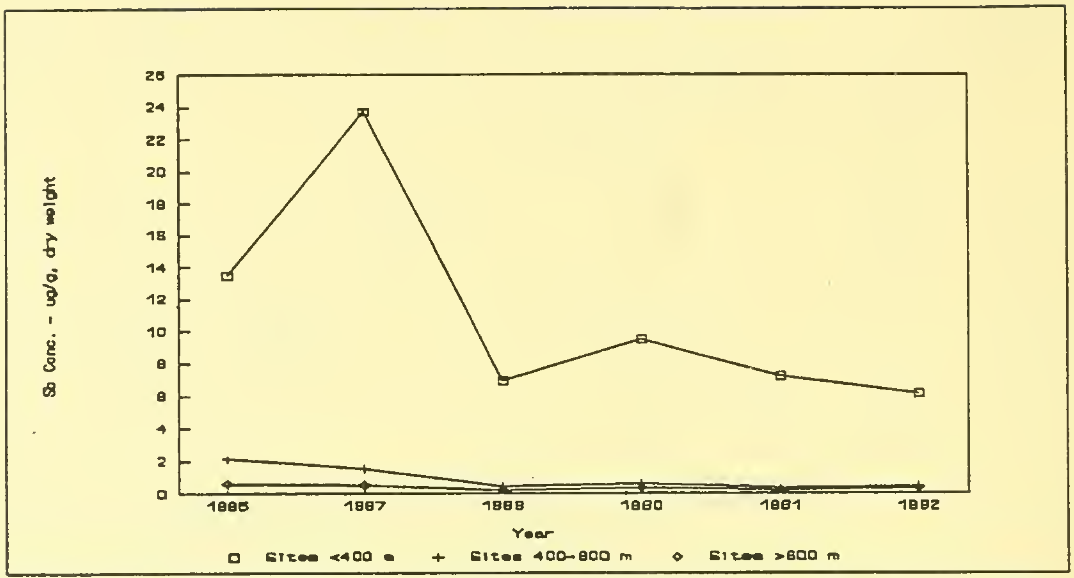


Figure 4: Mean Concentration of Antimony at Common Maple Sites: 1981-1992

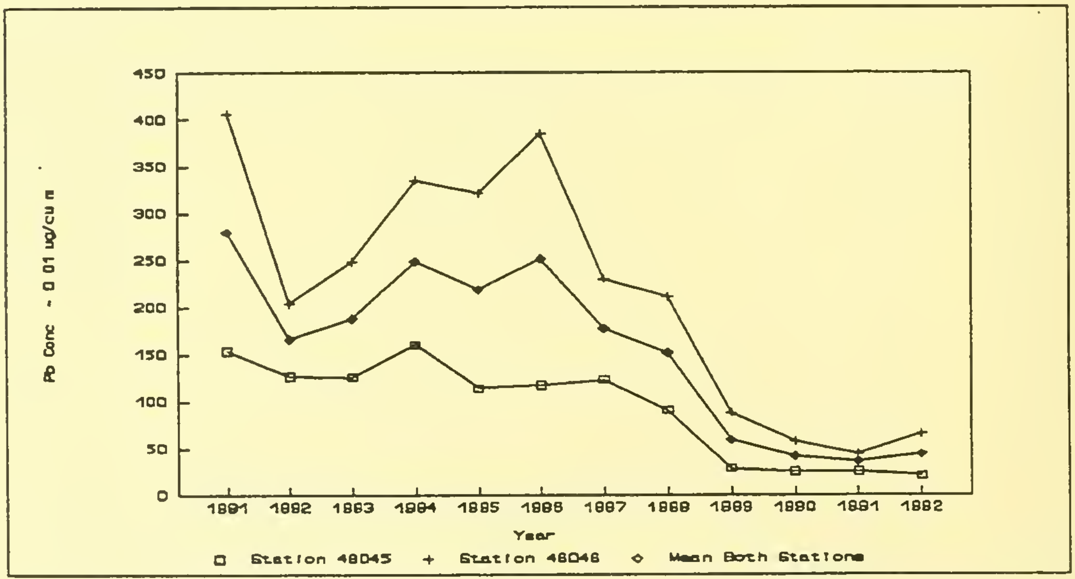


Figure 5: Annual (June-September) Mean Lead Concentration in Suspended Particulate: 1981-1992

APPENDIX

Derivation and Significance of the MOE Phytotoxicology "Upper Limits of Normal" Contaminant Guidelines.

The MOE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a pollution source. Urban ULN guidelines are based on samples collected from urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (reference: Ontario Ministry of the Environment 1992, Phytotoxicology Field Investigation Manual). Chemical analyses were conducted by the MOE Laboratory Services Branch.

The ULN is the arithmetic mean plus three standard deviations of the suitable background data for each chemical element and parameter. This represents 99% of the sample population. This means that for every 100 samples that have not been exposed to a pollution source, 99 will fall within the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOE Phytotoxicology ULNs are constantly being reviewed as the background environmental data base is expanded. This will result in more ULNs being established and may amend existing ULNs.